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# KESSEL RUN: AN ANALYSIS OF THE AIR FORCES INTERNAL SOFTWARE DEVELOPMENT ORGANIZAT

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# KESSEL RUN: AN ANALYSIS OF THE AIR FORCE'S INTERNAL SOFTWARE DEVELOPMENT ORGANIZATION

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**December 2019**

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The current method of acquiring custom, innovative software through traditional contracting methods is an outdated practice. These traditional methods are time-consuming, and could be improved with the Air Force's Kessel Run, an internal software development organization. With the Air Force's Kessel Run, the time from software inception to operation can go from years to days. Unfortunately, neither most of the Air Force nor the rest of the Department of Defense (DoD) has yet to catch up to the forward thinking of those involved in the creation of Kessel Run. Most of the Air Force and the DoD are still outsourcing for most of their innovative acquisitions, whether it be research and design or product (software) development. This case study offers insight to the new organization and identifies the potential to apply the concepts learned during its creation to benefit other DoD organizations when considering insourcing as opposed to the traditional outsourcing acquisition approach.

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## ABSTRACT

The current method of acquiring custom, innovative software through traditional contracting methods is an outdated practice. These traditional methods are time-consuming, and could be improved with the Air Force's Kessel Run, an internal software development organization. With the Air Force's Kessel Run, the time from software inception to operation can go from years to days. Unfortunately, neither most of the Air Force nor the rest of the Department of Defense (DoD) has yet to catch up to the forward thinking of those involved in the creation of Kessel Run. Most of the Air Force and the DoD are still outsourcing for most of their innovative acquisitions, whether it be research and design or product (software) development. This case study offers insight to the new organization and identifies the potential to apply the concepts learned during its creation to benefit other DoD organizations when considering insourcing as opposed to the traditional outsourcing acquisition approach.

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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ACC | Air Combat Command |
| AFB | Air Force Base |
| AFBIT | Air Force Business Intelligence |
| AFLCMC | Air Force Life Cycle Management Center |
| AOC | Air Operations Center |
| ATO | Authority to Operate |
| COTS | Commercial Off the Shelf |
| DAU | Defense Acquisition University |
| DevOps | Development and Software Operations |
| DevSecOps | Development, Cyber Security, and Software Operations |
| DoD | Department of Defense |
| ECSS | Expeditionary Combat Support System |
| FAR | Federal Acquisition Regulation |
| FPDS-NG | Federal Procurement Data System—Next Generation |
| FY | Fiscal Year |
| GOTS | Government Off the Shelf |
| IT | Information Technology |
| NAICS | North American Industry Classification Standard |
| OMB | Office of Management and Budget |
| OMTM | One Metric that Matters |
| OTA | Other Transaction Authorities |
| PSC | Product and Service Code |
| SaaS | Software as a Service |
| SIPR | Secret Internet Protocol Router |
| T&G | Targeting and Geospatial |
| U.S. | United States |

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# I. INTRODUCTION

This case study explores Kessel Run and seeks to provide an understanding of its insourcing approach and how that approach benefits its customers, when compared with the traditional outsourcing acquisition approach.

## A. BACKGROUND

According to the Defense Science Board, "some of the costliest failures in military procurement have been blamed on software. Pentagon officials over the years have been grilled on Capitol Hill on this issue, but billions of dollars continue to be spent on software projects that are way over budget and behind schedule" (Erwin, 2018). With these traditional methods, it may take years for a software product to travel through the procurement process from requirement inception to software deployment in the operational Air Force. According to Mark Wallace (2008), "standard DoD procedure requires systems like the AOC software to be competitively bid, and for the winning contractor to design, build, certify, and test the entire system before delivering it to users—and then to go through the entire process again each time any appreciable amount of code needed to be changed." The Air Force is countering the ineffectiveness of the traditional acquisition methods for custom, innovative software products with recently developed insourcing approaches. The Air Force's Kessel Run, an internal software development organization, has substantially decreased the amount of time it takes to field software—from years to weeks. Unfortunately, neither the rest of the Air Force nor the Department of Defense (DoD) has yet to adopt the forward-thinking initiatives involved in the creation of Kessel Run. The rest of the Air Force and the DoD are still outsourcing most of their innovative acquisitions, whether it be research and design or product (software) development (Kelman, 2019a).

The DoD has outsourced various functions throughout the decades, and the DoD is responsible for 64.77% of the federal government's fiscal year (FY) 2018 obligations, at $358.3 billion (WatchBlog, 2019). The DoD outsources services and products, with the following categories receiving the highest dollar amount in obligations:

- Aircraft, fixed wing
- Professional engineering/technical
- Combat ships and landing vessels
- General healthcare
- Guided missiles (WatchBlog, 2019).

Typically, contractors are described as private firms that provide contracted goods and services to the government (Congressional Research Service, 2017). In 2015, the top five defense contractors were Lockheed Martin Corporation, Boeing, Raytheon, General Dynamics, and Northrop Grumman, and these firms continue to be the top five U.S. defense contractors based on contract funds awarded in FY2018 (Congressional Research Service, 2017; Forecast International's Aerospace Portal, n.d.). According to the Congressional Research Service (2017), the top five defense contractors "dominate contracts for both products and services, largely because they also service the products they provide to DoD" (p. 1). Regarding services, the Congressional Research Service reports that DoD contractors can range from healthcare providers to researchers to management support providers. Additionally, over 70% of contractors provide commodities; these contractors "include the smallest companies by contracted dollars, which tend to provide specific manufactured goods" (p. 1). Furthermore, contractors can also be defined as individuals hired by the DoD through private companies to perform specific tasks, not to be confused with DoD civilians who are on the government payroll. In this context, DoD contractors perform many organizational functions, "from intelligence analysis or software development to landscaping or food service" (Congressional Research Service, 2017).

As the Defense Science Board stated, "software has become one of the most important components of our nation's weapons systems, and it continues to grow in importance" (Erwin, 2018, para. 2). According to Jones (2002), contractors are responsible for the bulk of U.S. defense software development. Furthermore,

> the broad definition of defense software includes a number of subclasses such as software associated with weapons systems; with command, control,

> and communication systems (usually shortened to C3 or C cubed); with logistical applications; and also with software virtually identical to civilian counterparts such as payroll applications, benefits tracking applications, and the like. (Jones, 2002, p. 26)

The F/A-22 aircraft received substantial criticism because of delays, largely due to "the difficulty of making the complex software dependable" (National Research Council, 2007, p. 18). Furthermore, the Air Force canceled a software program, Expeditionary Combat Support System (ECSS), in 2012 (Kanaracus, 2012). After having obligated $1.03 billion since 2005, the government decided that ECSS would too expensive to complete and anticipated costs of an additional $1.1 billion would outweigh the benefits (Kanaracus, 2012). Frustrations like these may have motivated the Air Force to reconsider its software development acquisition practices.

The make-or-buy decision is a business decision applicable to both the government and the private sector. Because the DoD's operation and support costs have not commensurately declined with the ongoing personnel reduction since the Cold War, the DoD has resorted to outsourcing or buying functions that are not considered core competencies (Grasso, 2005). According to Grasso's Defense Outsourcing: The OMB Circular A-76 Policy report (2005), "combined with a national mood reflecting a growing change in the public's perception of the role of government, a shrinking defense procurement budget, increased private sector lobbying for government contracts, the notion of contracting out, or outsourcing, of federal procurement activities has taken center stage" (p. 1). Furthermore, Grasso's Defense Outsourcing: The OMB Circular A-76 Policy report strongly encourages the use of cost comparisons whenever possible to determine the most economical way of acquiring goods or services in question.

Software development traditionally occurs through legally binding instruments governed by the Federal Acquisition Regulation (FAR), Air Force Installation Contracting Center guidance, and other regulatory bodies (Air Force Installation Contracting Center, n.d.; Federal Acquisition Regulation, 2019). Three common methods of traditionally procured custom software exist: the procurement of custom software as a commodity using typical contracting approaches, the procurement of software as a service (SaaS) using typical contracting approaches, and the procurement of custom software utilizing Other

Transaction Authorities (OTAs; "Other Transaction Authority," 2016). While all three methods rely heavily on industry efforts, the former two options are subject to the FAR as opposed to OTAs ("Other Transaction Authority," 2016). Procuring as a commodity or service is more conventional in the government, and it is typically how the government contracts with traditional defense contractors. OTAs provide an alternate route to attract additional contractors by means of establishing unconventional agreements. Furthermore, differences between commodity and services exist as well, offering flexibility to the Air Force. Commodity and services provide different benefits depending on the requirement; however, SaaS has become a more attractive software solution model in the private sector (Ma, 2007). According to Ma (2007), "in many cases, the SaaS may prove cheaper than owning and maintaining an in-house IT [Information Technology] system. Users expect to save money on support and upgrade costs, IT infrastructure, IT personnel, and implementation" (sec. "Introduction"). Kessel Run has altered the software development process and enables the Air Force to self-develop software. Kessel Run has significantly reduced software development lead time by providing agile software development. We explore Kessel Run's overall effectiveness by identifying the agency's contributing capabilities and limitations.

*Agile software development* is a term that has been referenced for over a decade, and concerted efforts have been made to achieve agile software development as early as the mid-1990s (Highsmith, 2002). According to Highsmith (2002), "A growing number of software projects operate in the equivalent of a battle zone—they are extreme projects. This is where agile approaches shine" (p. 4). Although these extreme projects follow a relatively clear mission, conventional plan-driven methods are not sufficient for these complex, volatile requirements that often follow erratic changes (Highsmith, 2002). Software development can fall into one of two processes: empirical or defined (Highsmith, 2002). Agile software development is an empirical process that necessitates adapting to changing conditions (Highsmith, 2002). A defined process "involves a relatively high degree of predictability and algorithm precision" (Highsmith, 2002, p. 4). According to Washington Technology, "the Air Force's chief technology officer wants to make sure all of its tech deals mimic its agile software development model Kessel Run" (Williams, 2018, para. 1).

Now that the Air Force is focusing on agile software development, Kessel Run has received considerable leadership support to develop defense software within weeks instead of years (Williams, 2018). However, this is not an easy transition because insourcing required the Air Force to revamp training for active duty members and defense civilians in coding and cyber defense core competencies that are unfamiliar to the current workforce (Williams, 2018). Investigating the initiation of Kessel Run will help us understand how the Air Force planned to close the training gap and its impact to agile software development through Kessel Run.

## B. MOTIVATION

DoD acquisitions have faced increased scrutiny for crippling acquisition schedule delays, massive cost overruns, and acceptance of poor end products (Wheeler, 2014). The Air Force's reliance on complex technology interfaces across air, space, and cyberspace make it particularly vulnerable to criticism in these areas, as can be evidenced by F-22, F-35, B-2, and KC-46 procurement challenges (Davenport, 2019). The Air Force has traditionally relied on outsourcing software development needs, but it has taken a new direction with Kessel Run. As contracting professionals in the Air Force, we have taken an interest in this alternate means of software development that eliminates the need to rely on industry to provide defense software.

Previous methods of software development have largely been performed by industry for the government; however, it is interesting that the Air Force decided to create an internal software development organization because it contradicts the traditional method of procurement by contracting. The purpose of this study is to understand how and why Kessel Run came into being to create a document to educate readers on the program. This study accomplishes the following objectives in our research:

- Provides an in-depth summary of the development of Kessel Run
- Identifies obstacles encountered in the development of Kessel Run
- Identifies Kessel Run's organizational purpose

- Discusses benefits gained and anticipated from Kessel Run
- Evaluates how and whether Kessel Run is meeting its intended purpose
- Describes struggles associated with software development through Kessel Run
- Documents the rationale of Air Force leaders to insource software development via Kessel Run

This study documents and assesses the case of Kessel Run and provides a potential framework for future military insourcing opportunities.

## C. RESEARCH QUESTION

This study explores why and how Kessel Run was developed in order to understand this Air Force initiative to internally develop (insource) software in lieu of the traditional method of procurement by contracting (outsource). While there are obvious differences between the two software development methods, the Air Force's motivation for launching and investing in Kessel Run remains unclear. Furthermore, this research seeks to understand the potential savings associated with the organization that stimulated the Air Force to insource software development by answering the following research question: How and why did Kessel Run come into being?

## D. RESEARCH METHODS AND SUMMARY OF FINDINGS

This case study research draws on three forms of data: 1) information provided directly by the Kessel Run staff and leadership, including information posted on official Air Force websites; 2) information collected from interviews from Kessel Run members; and 3) information posted publicly by those outside of the organization. The use of inside and outside perspectives allows comparison between the sources enhancing the rigor of the approach.

### 1. Summary of Findings

The summary of findings reviews why and how Kessel Run was created to educate readers on this innovative Air Force organization. Additionally, other Air Force and DoD leaders may find the case study applicable to future decisions on insourcing other operations. We draw key concepts from the case, including discovering Kessel Run's successes and limitations. If more capabilities are insourced, this information could serve as a baseline for military leaders as they make innovative and educated decisions from the research conducted on Kessel Run to lower costs, improve efficiency, increase compliance, and save taxpayer dollars.

### 2. Limitations

The case study research examines one specific Air Force agency in depth and may have characteristics that translate to insourcing opportunities outside of Air Force software development; however, limitations must be acknowledged that may necessitate further research. Qualitative research was conducted by interviewing Kessel Run members. The team made a diligent effort to conduct interviews systematically and without bias; however, the interview subjects are all members of Kessel Run and are therefore likely to share similar perspectives on the organization. Further research should include other stakeholders, such as contractors involved with the training program and customers and users receiving Kessel Run support.

Our research is limited to the information from the inception of Kessel Run to the present. More analysis could be conducted on Kessel Run, which is a relatively young agency. There is potentially more to be learned about Kessel Run in the future, and the organization may warrant additional study as new developments occur. Additionally, our research is based on a limited number of interviews focused on a single case. Further research involving additional interview participants and comparable cases from other services or industry could provide findings with broader relevance.

## E. CHAPTER OVERVIEW

The case study consists of six chapters. This research provides an analysis that can assist military leaders with converting contracted opportunities into insourcing operations. Chapter II provides a comprehensive summary of extent literature, explaining the make-or-buy decision, including the relevance of transaction costs, core competencies, competitive advantage, and applicable policy. Chapter III introduces the case study method and details the three forms of data collected in the research, along with method trustworthiness and limitations. Chapter IV provides a brief organizational history of Kessel Run. Chapter V reveals the analysis of the data collected and findings that resulted from the three forms of data. Finally, Chapter VI includes a summary of findings, implications, and recommendations for future research as a culmination of the first five chapters of the research.

# II. LITERATURE REVIEW

This chapter focuses on literature related to the make-or-buy analysis. The first section introduces the make or buy decision. The second section explores transaction costs. The third section discusses core competencies. The fourth section examines competitive advantages while the final section explores government policy.

## A. MAKE OR BUY

The decision to make or buy supplies or services within a firm can be complex and may lead to conflict, but it is one of the most important decisions to make as it drives other decisions and processes (Henriksen, Rolstadås, & O'Sullivan, 2012). Practically speaking, the make-or-buy decision is a decision on how a firm will manage its supply chain (Henriksen et al., 2012). Processes and strategies that are core to the firm should remain within the firm (make), while those that are not core to the firm can be outsourced (buy) (Henriksen et al., 2012). Managers must consider several factors and theories to make the appropriate decision. Namely, it is important to have an understanding of transaction cost economics, core competencies, and competitive advantage, along with how these concepts shape a firm's decisions.

Quinn and Hilmer (1994) proposed three questions that must be answered when considering a make or buy decision:

> First, what is the potential for obtaining competitive advantage in this activity, taking account of transaction costs? Second, what is the potential vulnerability that could arise from market failure if the activity is outsourced? ... Third, what can we do to alleviate our vulnerability by structuring arrangements with suppliers to provide appropriate controls yet necessary flexibilities in demand. (p. 48)

The answer to the first question necessitates an understanding of transaction costs, core competencies, and competitive advantage. The second and third questions require an internal Air Force analysis on acceptable risk profiles and market leverage to adequately address for other mission sets and may be fruitful areas of further research.

Firms engaging in strategic make-or-buy decisions must identify their core competencies (Prahalad & Hamel, 1990). By examining any competitive advantages that arise from those competencies, firms can determine their continued relevance to the organization (Leonard-Barton, 1992). If competencies remain relevant to competitive advantage, the organization should remove these competencies from the make-or-buy analysis and retain them in-house. If irrelevant to competitive advantage, the organization should consider the competency with the bulk of other tasks that may potentially be outsourced. Then, the organization must conduct transaction cost analysis to better discern what tasks should be kept in-house and what may be outsourced (Williamson, 1996).

## B. TRANSACTION COSTS

Transactions costs are the costs incurred by a firm in the process of conducting business (Chen, 2019). More specifically, transaction costs refer to costs associated with searching, communicating, and bargaining activities (Klein, 2013). Firms and organizations, including the Air Force, need to consider transaction costs when making decisions on how they conduct business. Consider a simple example where a business owner has determined that, although small, his business has grown large enough that it is no longer feasible for him to keep accurate accounting records using commercial off-the-shelf software; the software is still effective, but he just does not have the time to do it. The business owner has two choices: he can hire someone to keep accounting records for him or he can hire an outside firm that specializes in keeping accounting records for small businesses. Hiring someone costs $10 in salary and the outside firm costs $9 in fees. Although at first glance it seems apparent that the logical choice would be to hire the specialized accounting firm, the business owner has not yet considered the transaction costs of his decision. Some of the transaction costs are likely to be shared, such as the time it takes to search for an employee, which may mirror the time it takes to conduct due diligence on a firm to hire.

However, some costs may be singular to the outsourced firm, such as needing to communicate accounting information every month, or bargaining the workload to be carried. For example, a position description for an employee may read something similar

to “conduct accounting activities for all business transactions” and that should fulfill the owner’s needs perpetually or until the business grows large enough that the job is simply too much for one person and requires another. On the other hand, a contractual agreement with an outside firm is likely to be more limiting. There may be an agreed-upon limit to the number of records that the firm will process at the $9 rate. If the business grows, even marginally, the owner may need to conduct bargaining to ensure all of his records are accurately recorded. At the fundamental level, that costs time. Time, of course, is money or, in this case, transaction costs. If those transaction costs exceed $1, then hiring the firm may cost more to the business owner than the $10 salaried employee.

The Nobel economist Ronald Coase first conceptualized the idea of transaction costs in his article “The Nature of the Firm,” published in 1937 (Klein, 2013). While Coase’s purpose for his article was to define the term *firm,* which, at the time, was widely used but ill-defined, he succeeded in doing more. Coase explained, “The main reasons why it is profitable to establish a firm would seem to be that there is a cost of using the price mechanism” (1937, p. 390). The price mechanism to which Coase refers is the “invisible hand” specter that guides market transactions so that resources may flow to where they may be most efficiently utilized. Coase gave his abstract cost reference body by providing examples. The first such example is the cost of determining germane market pricing that, while able to be minimized through specialization (e.g., third-party pricing databases), cannot be avoided (Coase, 1937). Negotiating contracts for each transaction also represents a cost that firms can streamline although not eliminate completely (Coase, 1937). Coase did not explore every possible transaction cost, but he explained that executing transactions comes at a cost, and firms may reduce these transactions.

Oliver Williamson (1981) expanded on Coase’s exploration of transaction costs by authoring “The Economics of Organization: The Transaction Cost Approach,” where he described these costs as the economic counterpart to friction. While one may look to moving mechanical parts of a machine and the friction experienced where parts meet to judge its efficiency, Williamson explained that economic friction may arise in how cooperatively, or uncooperatively, parties interact. Williamson opined that “transaction cost analysis is an interdisciplinary approach to the study of organizations that joins

economics, organization theory, and … contract law" (p. 573). Transactional costs are more than just a reason for the existence of firms; they drive the way firms make decisions.

Williamson stated, "Whether a firm makes or buys—that is, produces for its own needs or procures a good or service from an outside supplier—turns largely on the transaction costs of managing the transaction in the firm, as compared with mediating the transaction through the market" (1996, p. 25). As discussed, these transaction costs represent the costs required to conduct business with outside vendors or to maintain the support infrastructure to fulfill the requirement organically. If filled organically, transaction costs can include training personnel, maintaining equipment, or similar costs (Coase, 1937). If outsourced, costs may be incurred for monitoring vendor performance or conducting lengthy negotiations (Coase, 1937). The firm must diagnose for itself what manner of fulfilling its need is most beneficial.

## C. CORE COMPETENCIES

Core competencies are another integral part of a firm's decision-making process. At its essence, a core competence embodies the strength of a firm and is typically something the firm has dedicated itself to perfecting. To borrow a definition from Melissa Schilling (2013), a core competency is "a harmonized combination of multiple resources and skills that distinguish a firm in the marketplace" (p. 117). To be successfully employed by a firm, Prahalad & Hamel identify three criteria a core competency must meet:

- provide access to a wide variety of markets.
- make a significant contribution to perceived customer benefits.
- be difficult for competitors to imitate. (Prahalad & Hamel, 1990, p. 7)

If a firm's competence does not meet all three criteria, or if the firm fails to continuously develop and invest in the competence, then the core competency will either have a short existence or fail to materialize at all.

Requiring that the competency access a wide variety of markets only means that the desired competence should not be so niche as to be unemployable in other business areas. Take Amazon, for example. One of Amazon's core competencies is customer service, or the customer experience as noted in their mission statement "to be the Earth's

most customer-centric company" (Amazon Jobs, n.d.). A dominating drive to create the absolute best customer experience in the world led an online bookseller to become the largest online retailer of myriad goods and services and to expand into other markets such as Amazon Web Services (Cerasoli, Janousek, & Mills, n.d.). Amazon's customer service competency readily satisfies the second criterion as well; shoppers enjoy and appreciate the ease with which they can maneuver and buy items on the website and the benefit to consumers is easy to identify (Cerasoli et al., n.d.). Perhaps unexpectedly, Amazon's competency indeed satisfies the third criterion primarily because of the scale in which it influences how Amazon operates. No other retailer is as succesful as Amazon in creating a positive customer experience as evidenced by their position as the number one company with regards to customer experience (Feinberg, Benki, Berry, & Sylvester, 2018). This is what makes the competency so challenging for other firms to imitate.

Rather than prioritize the individual business unit, Prahalad & Hamel (1990) argued that firms should prioritize building competencies across business units. Focusing on competencies, they argue, unlocks synergy throughout the firm (Prahalad & Hamel, 1990). When a firm is able to grow and maintain core competencies, competitive advantages arise that give the firm an edge over its competition (Prahalad & Hamel, 1990).

Further developing the core competency concept, Quinn and Hilmer expanded to seven characteristics of effective core competencies:

1. Skill or knowledge sets, not products or functions
2. Flexible, long-term platforms—capable of adaptation or evolution
3. Limited in number
4. Unique sources of leverage in the value chain
5. Areas where the company can dominate
6. Elements important to customers in the long run
7. Embedded in the organization's systems. (Quinn & Hilmer, 1994, pp. 45–47)

Comparing the two criteria list, similarities become evident. To satisfy Prahalad and Hamel's requirement that core competencies access wide markets, it is sensible that skill or knowledge sets, not a unique product, would exist as a core competence (Quinn & Hilmer, 1994). To satisfy customers, it is practical that a competence not only focus on

service to customers but also be flexible to adjust to their customers as preferences change over time (Quinn & Hilmer, 1994).

Because core competencies are integral to firm strategies, firms do not intentionally outsource core competencies (Hudgens, 2008). Sometimes, core competencies may become unnecessary or harmful. Leonard-Barton (1992) defined harmful core competencies as "core rigidities" (p. 188) and explores how previously beneficial competencies can hinder the development of new or innovative capabilities. An organization would be well served to abandon, or limit the influence of, any competencies that have become problematic (Leonard-Barton, 1992).

Core competencies not characterized by Leonard-Barton's (1992) core rigidity problem should be performed by the firm. Prahalad and Hamel (1990) offer the example of Chrysler and Honda from the 1980s. Chrysler viewed its engine and powertrain components only as pieces of a larger whole, the vehicle. The firm sought to differentiate elsewhere and thus outsourced powertrain manufacture. Honda, on the other hand, sought to turn its engines into a core competency. The firm established this through its heavy investment in racing engines, which enabled the firm to recognize synergy in engine development research. Honda's engines became defining characteristics. It would be senseless for Honda to outsource this core competency.

## D. COMPETITIVE ADVANTAGE

Also germane to understanding the make-or-buy analysis is the influence competitive advantages have in decision-making within firms. Competitive advantages arise when one firm is able to create more value through resource utilization than other companies, and these competitive advantages generally arise from a firm's core competencies (Prahalad & Hamel, 1990). There are two different perspectives that are used to discuss competitive advantages: a resource-based perspective and an institutional perspective (Oliver, 1997).

The resource-based perspective emphasizes that the resources available to a firm should shape how that firm secures a competitive advantage. According to Peteraf, the resource-based model consists of four conditions which must be met:

1. Resource heterogeneity
2. Ex ante limits to competition
3. Imperfect resource mobility
4. Ex poste limits to competition. (Peteraf, 1993, pp. 180–185)

We explore these in brief detail, but they are presented in no particular order.

The first condition required for the resource-based view of competitive advantage is that resources must exist heterogeneously. That is, resources cannot be spread evenly throughout the field of firms (Peteraf, 1993). Barney (1991) offered positive reputations of firms as an example of resource heterogeneity. When only a handful of companies in a particular competitive market enjoy a positive reputation, their reputations exist as a rare resource (Barney, 1991). This resource is not immediately mobile nor equally enjoyed by all firms and therefore satisfies the first condition.

A second condition that must be present is ex ante limits to competition. Peteraf (1993) explained that the meaning of this condition is that "prior to any firm's establishing a superior resource position, there must be limited competition for that position" (p. 185). For example, take Apple's introduction of the iPhone. Apple identified a differentiated market in the now-ubiquitous smartphone. With limited competition for the position, the firm swiftly and enduringly established dominance (Vogelstein, 2008).

A third necessary condition is that of imperfect resource mobility, which essentially means resources are either completely immobile and cannot be traded, have individual use to a firm and no value to another, or they have more value within the firm than if they were traded out of the firm (Peteraf, 1993). Perhaps the most common imperfectly mobile, or in some cases perfectly immobile, resources are intangible resources such as intellectual property, patents, and manufacturing processes (Jurevicius, 2013).

The fourth and final required condition are ex post limits on competition. Peteraf (1993) explained this condition as limiting factors on competition after a firm has achieved superior position exploiting immobile, heterogeneous resources, typically achieved through imperfect substitutability and imperfect imitability. Substitutability is easy to grasp just by looking at the paper towel shelves in your local grocer or department store. While some consumers may have brand preference or brand loyalty, thin absorbable paper

products are hardly exclusive. Imperfect imitability can be much more variable in what it may consist of, but for our purposes, think of it in similar terms as the intangible resources discussed above. Through the development of many interrelated trademarks, a firm may create brand recognition that other firms find inimitable. Or, as was the case with Toyota decades ago, their manufacturing process was inimitable and American firms struggled to compete (Bowen & Spear, 1999).

The opportunities for competitive advantages emerge through the four conditions Peteraf (1993) outlined. The existence of the four conditions does not precipitate a firm's competitive advantage in a market. It only enables a firm to seize a competitive advantage. Expert managers must still realize the opportunity to secure the upper hand (Peteraf, 1993).

The institutional perspective of competitive advantage represents a different point of view. Zukin and DiMaggio (1990) suggested that economic rationality is not the sole driver of firm behavior but that social pressures can be just as influential as economic rationality. Instead of looking at resources, the institutional perspective focuses on social influences through accepted norms, values, and assumptions that society has deemed appropriate (Oliver, 1997). In practice, the influence of institutional theory concepts on firm behavior can impede or define competitive advantage practices (Oliver, 1997).

A generic illustration of a sports star should serve as an adequate example of how the institutional perspective can influence decisions. A player, essentially a sole proprietorship firm, in a particular sport is a top player at his position. His current team gave him his first chance when he was a nobody, and now his contract with the team is ending. Although his team can afford to pay him a fair salary for another contract, he accepts less than half of his value, as compared to other top players, and signs with the same team (Manfred, 2013). By signing at a discount, his team has enough money to address other positional concerns (Manfred, 2013). Despite being economically better off choosing the higher salary, the player was influenced by societal values of loyalty and organizational belonging to accept less money (Manfred, 2013).

It appears that the institutional perspective is not as deeply explored in the literature as the resource-based perspective. Oliver's (1997) intention was not to juxtapose the two

theories but to present a combined model. Exploring that model, however, is not necessary for our brief overview of competitive advantage and the theories behind it.

Since competitive advantages arise from core competencies, by definition, they cannot (or at least should not) be outsourced (Hudgens, 2008). A competitive advantage should be based on capabilities or resources that are heterogeneous and inimitable. If a firm were to successfully outsource a capability that it identified as a competitive advantage, two of the criteria that Peteraf identified as necessary are violated.

## E. GOVERNMENT POLICY

Government and DoD outsourcing policy is rooted in U.S. Code. Further regulations and policies are implemented through national defense authorization acts passed by Congress and the Office of Management and Budget (OMB) in OMB Circular A-76 (OMB, 1999; Robbert, Gates, & Elliott, 1997). The document authorizes government insourcing in four distinct circumstances: no satisfactory commercial sources available, matters related to national defense, patient care, and lower cost (OMB, 1999). The OMB (1999) clarified that "the general policy of the Government [is] to rely on commercial sources to supply the products and services the Government needs," (p. 1). Formal policy further states that "it is the policy of the United States Government to: achieve economy and enhance productivity, retain Governmental functions in-house, and rely on the commercial sector" (OMB, 1999, p. 1-2).

The DoD relies on the national defense insourcing language to exclude 58% of 640,000 positions conducting commercial activities from outsourcing (Robbert et al., 1997). The same report cites several studies that identify savings, both from insourcing and outsourcing activities, ranging from 20% to 35%, although inconsistencies related to actual versus projected savings may exist (Robbert et al., 1997). DoD-specific policy is driven by two DoD Directives: 4100.15 *Commercial Activities Program* and DoD Instruction 4100.33 *Commercial Activities Program Procedures* (Robbert et al., 1997). Directive 4100.15 essentially parrots OMB Circular policy and assigns responsibilities to government positions, while Directive 4100.33 describes the procedures for determining whether government personnel or commercial sources should satisfy needs (Office of the

Under Secretary of Defense for Acquisition, Technology, & Logistics, 1985a; Office of the Under Secretary of Defense for Acquisition, Technology, & Logistics, 1985b). More recently, DoD Directive 1100.4 Guidance for Manpower Management (Office of the Under Secretary of Defense for Acquisition, Technology, & Logistics, 2005) detailed policy stating that "assigned missions shall be accomplished using the least costly mix of personnel (military, civilian, and contract) consistent with military requirements and other needs of the Department" (p. 3).

Policy indicates that commercial activities not subject to the four exceptions should be outsourced to commercial activities. However, DoD Directive 1100.4 goes further and mandates that personnel address military needs with the least costly mix of labor, implying that DoD policy encourages outsourcing for cost reduction versus attempting to focus on core competencies (Office of the Under Secretary of Defense for Acquisition, Technology, & Logistics, 2005).

Air Force Policy Directive 38-1 (Secretary to the Air Force, 2019) echoes DoD Directive 1100.4 by also requiring the least costly mix of personnel to meet military and Air Force needs. One of the newer initiatives across the government and championed by the Air Force is category management. The Government-Wide Category Management Guidance Document (Office of the Secretary of Defense, 2015) contains no reference to core competencies or competitive advantages while returning 91 instances of "cost" and 48 instances of "saving." Given the policy documents, directives, and current focus on category management, it would appear that the government's make-or-buy decisions are primarily driven by cost reduction objectives instead of core competency–focusing objectives.

# III. METHODS

This chapter focuses on the case study methodology, what it is, why it was used, and how it was used. The first section introduces and defines the case study methodology. The second section identifies the three different types of case study and identifies the type we use in this study. The third section addresses some of the misunderstandings about case studies. The fourth section identifies the three types of data the research team collected on Kessel Run, why we collected each type, and what we hoped to learn from each. The fifth section discusses the data collection and analysis. The sixth section explains why our analysis and results can be trusted based on our chosen method. Finally, the seventh section identifies some limitations or weaknesses associated with our method.

## A. CASE STUDY METHOD

### 1. Definition

This section introduces case study method by first defining it. It is difficult to find a consensus as to what a "case study" or even a "case" actually is. In the 2008 article "Case Studies: Types, Designs, and Logics of Inference," Levy stated that some would agree that a case is merely an "instance." George and Bennett (2005) added to that concept, stating that a case is "an instance of a class of events" (p. 5). Levy stated that a case study is "an attempt to understand and interpret a spatially and temporally bounded set of events" (Levy, 2008, p. 2). George and Bennett (2005) defined a case study as "the detailed examination of an aspect of a historical episode to develop or test historical explanations that may be generalizable to other events" (p. 17). In 2018, Yin provided an arguably easier interpretation of the term.

Yin (2018) stated that a "case study" is simply a certain kind of research method and a "case" is defined as the main focus of a case study, a "concrete entity (e.g., a person or group, organization, community, program, process, policy, practice, or institution, or events such as decisions)" (p. 286). The popularity of the case study method of research has greatly increased over time from a less "obscure mode of inquiry" to being better understood and valued (Yin, 2018, p. 14). The definition is also something that has

developed over time. Yin (2018) has been developing the definition over the five previous editions of his book, *Case Study Research and Applications* (6th ed.), and has been able to break it down into a twofold definition. The first part consists of the scope of a case study:

1. The case study method is empirical, in that it:

    a. investigates a contemporary phenomenon (the 'case') in depth and within its real-world context, especially when
    b. the boundaries between phenomenon and context may not be clearly evident. (p. 15)

The second part of the definition concerns the "methodological characteristics" (Yin, 2018, p. 15). Accordingly, the methodological characteristics become the features of the case study. Yin (2018) continued his definition with the following:

2. A case study:

    a. copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result;
    b. benefits from the prior development of theoretical propositions to guide design, data collection, and analysis, and as another result;
    c. relies on multiple sources of evidence, with data needing to converge in a triangulating fashion. (p. 15)

In the first bullet of the second part of his definition, Yin stated that "there will be many more variables of interest than data points" (p. 16). In regard to Kessel Run, the research team's interest in the organization goes beyond data points such as cost savings (contract or otherwise), time savings (Procurement Action Lead Time [PALT]), and customer satisfaction; instead, our interest stems from a group's ability and determination to practice intellectual and entrepreneurial freedom. The potentially explanatory variables of interest are numerous. The more variables of interest, the more complex the case and its context (Yin, 2018).

## 2. Types of Case Studies

This section identifies case study types. Case studies typically exist in three distinct forms: descriptive, explanatory, or exploratory. Yin (2018) stated that the boundaries on when to use the different methods, or modes, are not always evident. He also added that

even though each of the types has its distinct characteristics, there can be large overlaps between them. Meaning, while there are instances when more than one mode could be used, the major mistake typically made is using one mode when another would be more advantageous (Yin, 2018). This case study focuses on an explanatory analysis of Kessel Run to provide background and rationale for its beginning. To support our choice of an explanatory study, we examine each of the case study types.

### *a. Descriptive*

According to *Case Study Research*, a descriptive case study is "a study whose purpose is to describe a phenomenon ('the case') in its real-world context" (Yin, 2018, p. 286). According to the Association of Collegiate Schools of Planning (n.d), the descriptive case study "uses a narrative-type framework that focuses on a real-world problem and provides essential facts about it, including relevant background information." Furthermore, it "introduces readers to key concepts, policies, and tools (including quantitative tools) relevant to the question or problem." Additionally, it "explains the solution, the process of implementing it, and the results." Finally, it "offers analysis and evaluation of the chosen solution, its implementation, and the outcomes, including strengths and weaknesses, trade-offs, and lessons learned" (Association of Collegiate Schools of Planning, n.d., p. 1).

### *b. Explanatory*

According to *Case Study Research*, an explanatory case study is a "study whose purpose is to explain how or why some condition came to be (e.g., how or why some sequence of events occurred or did not occur)" (Yin, 2018, p. 287). The type, or mode, to be used can be based on the research question and how the question was posed. For example, "how" and "why" questions are more explanatory which supports the use of the case study, history, or experiment as the preferred method of research (Yin, 2018). Case studies are preferred for "how" and "why" questions because these questions are good for examining an operational process over a time frame as opposed to examining or evaluating event frequencies or specific events (incidences) (Yin, 2018). Explanatory case studies rely on theory to provide the basis upon which a researcher forms and defends a position (Yin, 2018). In such a case, the specific avenue is used to justify the researcher's position.

### *c. Exploratory*

According to *Case Study Research*, an exploratory case study is "a study whose purpose is to identify the research questions or procedures to be used in a subsequent research study, which might or might not be a case study" (Yin, 2018, p. 287). In some instances, fieldwork and data collection are conducted prior to defining the research question and hypothesis. Tellis writes, "This type of study has been considered as a prelude to some social research" (1997, p. 7). Even though this type of study allows advanced fieldwork, it is still required to have the framework of the case study identified or developed ahead of time. These exploratory methods are useful in determining what final protocols are used in the subsequent research study (Tellis, 1997).

## 3. Misunderstandings about Case Study Research

This section expands on case studies by identifying some of the misunderstandings about them. We wanted to confirm that the case study method was the right route to take when evaluating Kessel Run. When conducting research, we found that there were not only different types of case studies but also common misconceptions and misunderstandings about case study research. The following is what the team used to confirm that the case study method was the correct path to take.

In "The Five Misunderstandings about Case-Study Research," Flyvbjerg (2006) focused on the importance of case studies and set out to disprove five common misunderstandings about case study research, and to argue that the five "misunderstandings" are actually acceptable and sometimes necessary. Flyvbjerg's specific argument in this article is "that a scientific discipline without a large number of thoroughly executed case studies is a discipline without systematic production of exemplars, and a discipline without exemplars is an ineffective one" (p. 219). He was always told,

> "You cannot generalize from a single case," some would say, "and social science is about generalizing." Others would argue that the case study may be well suited for pilot studies but not for full-fledged research schemes. Others again would comment that the case study is subjective, giving too

much scope for the researcher's own interpretations. Thus, the validity of case studies would be wanting, they argued. (Flyvbjerg, 2006, p. 219)

Flyvbjerg (2006) wanted to disprove these false assumptions about case studies. He presented and refuted five assumptions specifically:

1. General, theoretical (context-independent) knowledge is more valuable than concrete, practical (context-dependent) knowledge.
2. One cannot generalize on the basis of an individual case; therefore, the case study cannot contribute to scientific development.
3. The case study is most useful for generating hypotheses; that is, in the first stage of a total research process, whereas other methods are more suitable for hypotheses testing and theory building.
4. The case study contains a bias toward verification, that is, a tendency to confirm the researcher's preconceived notions.
5. It is often difficult to summarize and develop general propositions and theories on the basis of specific case studies. (p. 221)

Flyvbjerg (2006) explained the difference between what one can learn from case studies as opposed to what one can learn from context-independent, or theoretical-type, studies, which would only bring one to a beginner's level of understanding on the subject. Flyvbjerg reasoned that rule-based knowledge cannot comprise the highest level of education when it comes to a specific discipline, so the case study method of actual experiences with actual outcomes is critical to reaching higher levels of understanding and comprehension. Lastly, he addressed and refuted each specific false assumption. He provided several examples of current and historical events where case study analysis was critical in creating expertise in specific scientific disciplines, draws on other authorities who suggest case study research is valuable, and notes examples of single cases influencing scientific communities and research streams.

Based on the arguments in favor of the case study method, we adopted the case study method for our study on Kessel Run.

## B. KESSEL RUN DATA COLLECTION AND DESIGN

### 1. Kessel Run Case Study Information and Data Collection

This section identifies the data we collected, why it was collected, and what we hoped to learn from it. We collected information and data in three forms: 1) information

provided directly by the Kessel Run staff and leadership, including information posted on official Air Force websites, 2) information collected from interviews with Kessel Run members, and 3) information posted publicly by those outside of the organization.

The first data is what was provided directly by the Kessel Run staff and leadership, whether supplied directly through email or posted on an official Air Force website. The information provided by the Kessel Run staff is information they use during the organization's "Enablement Days." The information the staff provided included presentations as well as supplemental background documents. According to two Kessel Run staff members, Enablement Days are monthly gatherings to "enable other organizations to understand and incorporate some of the lessons we've learned on our way to where we are today. These sessions are led by our Deputy Commander ... who will cover topics ranging from operations to contracting" (participant, personal communication, August 13, 2019). Additionally, as stated, the Enablement Days are "very beneficial to get an understanding of the history of Kessel Run and the [Commercial Off the Shelf] COTS vs [Government Off the Shelf] GOTS conversation" (participant, personal communication, August 13, 2019).

We collected this data based on recommendations by the Kessel Run staff, who stressed the usefulness of the documents and presentations as being able to answer most of our questions. In addition to the information provided by the Kessel Run staff for Enablement Days, we also collected information from Kessel Run's official website as well as official information released to the public for the same reason. As there can be multiple perspectives as to why and how Kessel Run was created, the leaders at Kessel Run want information released that is sanctioned by them because that is what they believe people outside of the organization should know. Accordingly, we collected additional data in other ways.

The second form of data comes from responses to interview questions. We developed a list of interview questions structured to provide us with the data required to understand the creation of Kessel Run. After receiving approval through Kessel Run's leadership and the Naval Postgraduate School's Institutional Review Board, the team sent out the interview questions to 10 participants. The team requested names and email

addresses of 10 personnel "who have been with the organization since the beginning and/ or people who have background knowledge of Kessel Run's inception" (participant, personal communication, September 30, 2019). The participants were chosen by the chief of staff of Kessel Run and included six military and four civilian personnel. The military ranks and grades varied from junior to mid-level officers who filled both technical and leadership roles. The positions varied from "Product Lead" to "Branch Chief." The four government civilians held equivalent roles and positions. We noted the selection of some of the junior ranking offers identified for the interview, surmising that the junior officers may have had limited exposure and background knowledge of Kessel Run's inception. The chief of staff responded, "The list are those that have been with Kessel Run since its inception, or close thereto. They have quickly moved up the ranks and have excellent insight from a worker bee level to a more management role" (participant, personal communication, October 1, 2019). The response provided by the chief of staff satisfied the concerns of the research team. Per our request, in addition to the 10 personnel mentioned above, the interview questions were specifically sent to four senior leaders of Kessel Run, two lieutenant colonels and two civilians.

The interview data was collected to document the opinions of the staff and members of Kessel Run. We wanted to know individual participant's views on how Kessel Run was created, why it was created, and how it is doing so far. We wanted to assess similarities and disparities between their opinions and the information provided to the public through official venues. We hoped to obtain information, perceptions, and insight other than what is provided, posted, and vetted by leadership. We hoped to receive candid and elaborate responses from members who have lived and worked through the experience. These responses provide insights as to what happened during the decision meetings prior to the creation of the organization. They provide background into the make-or-buy decision, the transaction cost factors, or other insights as to why they decided to insource software development instead of outsource it.

The third form of data we collected is that which is posted publicly by those outside of the organization. This specifically includes information, research, and opinions of others who have researched Kessel Run and who are not affiliated with the organization. This

information came from sources such as blogs, civilian websites, and other (non-Kessel Run related) government websites.

We collected this data from external sources to identify reasons that were unknown or not documented in the data from within the organization. This outside, third-party perspective allowed us to compare and contrast with the data from within the organization.

### 2. Research Design—Steps Taken to Collect and Analyze the Data

This section describes the steps we took to collect and analyze the data. Each of the three forms of data required its own individual methods of data collection analysis. The three forms of data are: 1) information provided directly by the Kessel Run staff and leadership to include information posted on official websites, 2) data collected from interviews from Kessel Run members, and 3) information posted publicly by those outside of the organization. We will elaborate on how we collected and analyzed the data in the following paragraphs.

The first form of data came directly from the Kessel Run staff and leadership and included information posted on Air Force official websites. After being contacted, the Kessel Run staff was gracious in providing information on their organization. Due to their popularity, they created a monthly briefing called "Enablement Days," designed to "enable other organizations to understand and incorporate some of the lessons we've learned on our way to where we are today. These sessions are led by our Deputy Commander ... who will cover topics ranging from operations to contracting" (A. Graham, personal communication, August 13, 2019). Additionally, Enablement Days are "very beneficial to get an understanding of the history of Kessel Run and the COTS vs. GOTS conversation" (H. Hunt, personal communication, August 13, 2019). The information was emailed to the research team by A. Graham on August 13, 2019. We also collected information posted on Air Force official websites. The research team was able to search ".gov," ".mil," and ".af.mil" websites through public networks to collect what Kessel Run leadership approved to be posted about the organization.

The second form of data comes from responses to interview questions. We developed a list of interview questions structured to provide us with the information

required to understand the creation of Kessel Run. We interviewed Kessel Run staff and employees to get a non-leadership opinion on why Kessel Run was created and how it is doing so far. The team specifically wanted to send the interview questions via electronic mail (email) to give the respondents time to absorb the questions, gather their thoughts, and expand on their answers. Additionally, email responses would eliminate the need to transcribe the responses and reduce response misinterpretations.

The third form of data is that which is posted publicly by those outside of the organization. This specifically includes posted information, research, and opinions of others who have researched Kessel Run and who are not affiliated with the organization.

To streamline the analysis, we mirrored the research topics and areas for the first and third forms of data to that of the interview questions; this allowed the team to compare and contrast the data. The interview questions were as follows:

1. What is your position/duty title?
2. How long have you been with the organization?
3. What is the purpose of Kessel Run?
4. Why was Kessel Run created?
5. What was the primary objective for developing Kessel Run?
6. Outsourcing is the traditional method to procure software; how has outsourcing proved to be less effective?
7. What were the major obstacles with developing Kessel Run?
8. Did Kessel Run borrow ideas or concepts from other programs/ organizations? If so, what were they?
9. Which programs get selected for insourcing vs. outsourcing? Please describe the program selection process.
10. What is the status of Kessel Run? Is it meeting anticipated objectives?

11. How has Kessel Run impacted the Air Force's software development capabilities?

12. What are Kessel Run's notable successes?

13. What operational challenges has Kessel run experienced?

14. What are some important metrics for Kessel Run and how were they developed?

We developed these questions to better understand why Kessel Run was created, the purpose of its creation, and what factors went into the final decision to create a unique unit to insource a function in an organization (the Air Force) that traditionally outsources those functions.

## C. TRUSTWORTHINESS AND LIMITATIONS

### 1. Trustworthiness

This section explains why our analysis and results can be trusted. We collected and analyzed three forms of information from several sources: 1) official information that was approved/released by Kessel Run leadership, 2) interview data from Kessel Run members and staff, and 3) data results and analysis from independent researchers not directly associated with Kessel Run. According to Yin (2018), when it comes to the collection and analysis of data, research teams can either focus on a single source of evidence or use multiple sources of evidence. Yin explained that using multiple sources of evidence is "a major strength of case study data collection" and has termed this method as "data triangulation" (2018). Although the use of multiple sources of evidence can be viewed as a burden, based on the perceived level of effort and aligning findings and conclusions, we view their use as critical when it comes to strengthening the construct validity of our case study. As Yin (2018) stated, "The multiple sources of evidence essentially provide multiple measures of the same phenomenon" (p. 128). The phenomenon our team wants to focus on is why the Air Force created an agency to insource software development when the traditional method is to outsource. Once our team collected the data from the three sources,

we compared the data to understand why Kessel Run was created. Our research team is confident that our analysis is trustworthy through the utilization of "data triangulation."

### 2. Methodology Limitations or Weaknesses

This final section identifies some limitations or weaknesses with our methodologies. The research team identified three limitations in the method of our research: 1) the newness of the Kessel Run organization, 2) the chosen respondents for the interview, and 3) the number of interview respondents. The first limitation is due to the recent stand-up of Kessel Run; meaning, there is not a lot of data in terms of its success and/or failures. The team chose an organization that is doing something revolutionary in terms of software development insourcing; however, is there going to be enough data to validate the results of this case study? Kessel Run is a fairly new organization, standing up as an independent organization in May 2018. It can be argued that, being in its infancy, it has not had enough time to perform in order for this research team to develop a fully informed opinion. On the other hand, since our focus is why and how the organization formed, this limitation might be less concerning.

The second and third limitations involve the interview sources of evidence, one being the chosen respondents and the other being the number of respondents. We believe that utilizing Kessel Run staff and employees as respondents was the best way to get a non-leadership perspective on why and how the organization came to be. That being said, we also believe that utilizing this specific pool of interviewees can also be a weakness; specifically, there could be a bias or group-think. To combat this limitation, the team made diligent effort to ask questions without biases and conduct interviews objectively; however, the interview subjects are all members of Kessel Run and are therefore likely to share similar perspectives on the organization. We also try to minimize the impacts of this limitation through our strategy of data triangulation.

The second limitation concerning the interview respondents is the number of participants requested. Our goal was to receive between six and 10 responses. To receive this number, the team requested the names and emails of 10 individuals who were there during Kessel Run's inception or that have knowledge about it. To ensure an adequate

number of responses was received, the team requested that the point of contact at Kessel Run, the chief of staff, forward the interview to four members of the leadership team. While we received adequate participation from a range of personnel, our small sample is nonetheless a limitation.

# IV. KESSEL RUN

This chapter introduces the Kessel Run organization. The first section identifies when the organization stood up and why it stood up. The second section identifies the agency's mission and vision. The third section explains how Kessel Run operates and where the organization is located. The fourth section discusses the organization's function.

## A. KESSEL RUN: WHEN AND WHY

The naming of Kessel Run comes from the movie *Star Wars* during the scene where the character Han Solo is showing his starship to Obi-Wan Kanobi. Han Solo tells Obi-Wan that his starship is so fast that it did "the Kessel Run in less than 12 parsecs" (Kelman, 2019b). The Air Force wanted a way to correlate the new organization with speed and agility, so they named the organization "Kessel Run" (Kelman, 2019b).

Although Kessel Run stood up as an independent organization in May 2018, its inception started back in August 2017 and was initiated by the Targeting & Geospatial Intelligence (T&G) Modernization Program and the recently terminated Air Operations Center (AOC) 10.2 program (A. Graham, personal communication, August 13, 2019). According to the *Kessel Run Acquisition and Contracting Playbook*, which was provided to us via personal communication, Kessel Run was originally developed to fill a specific goal, which was to

> Deliver Air Operations Center (AOC) 10.2 Dynamic Targeting Mission Thread, including modern platform and automating associated 3rd party systems, alongside AOC 10.1 at 609th (AFCENT [Air Force Central Command]) in <12 months; initial delivery within 90 days of letting contracts ... nominally six (6) applications in initial phase. (A. Graham, personal communication, August 13, 2019)

Kessel Run quickly expanded to T&G's and AOC's entire portfolio, which was a direct reflection of the value they provide. Now, they are a detachment within the Air Force Life Cycle Management Center (AFLCMC/HBH) (A. Graham, personal communication, August 13, 2019).

## B. MISSION AND VISION

According to the *Kessel Run Acquisition and Contract Playbook* (A. Graham, personal communication, August 13, 2019), the mission of Kessel Run is to "continuously deliver war-winning software our Airmen love." Additionally, the vision of Kessel Run is to "build a software company that can sense and respond to conflict in any domain, anytime, anywhere" (A. Graham, personal communication, August 13, 2019). Upon reading the mission and vision, it is apparent the mission reads similar to civilian software development agencies, like Google, which highlight the importance of employee satisfaction and its correlation to productivity and creativity (Forbes Technology Council, 2018). The vision is closer to the typical military vision, which incorporates the wartime ("conflict") mission and rapid ("anytime") deployment.

According to a 2019 presentation from Lieutenant Colonel Jeremiah Sanders, "Kessel Run—The Agile Imperative," Kessel Run provides the 24 "key capabilities" broken out into five capability categories. The Kessel Run team references the 24 capabilities from *Accelerate: The Science of Lean Software and DevOps: Building and Scaling High Performing Technology Organizations* by Forsgren, Humble, and Kim (2018). The 24 capabilities are:

Continuous Delivery Capabilities

1. Version control all prod [sic] artifacts
2. Automate deployment process
3. Continuous Integration
4. Trunk-based development
5. Test automation
6. Manage test data
7. Shift left on security
8. Continuous Delivery

Architecture Capabilities

9. Loosely coupled architecture
10. Architect for empowered teams

Product and Process Capabilities

11. Customer (end-user) feedback
12. Workflow visible through value stream
13. Small batch sizes
14. Enable team experimentation

Lean Management and Monitoring Capabilities

15. Lightweight change approval process

16. App & infrastructure monitoring inform business decisions
17. Proactive system health checks
18. Work-in-process limits
19. Visualize work to monitor quality and communicate throughout the team

Cultural Capabilities

20. Westrum-style generative culture
21. Encourage and support learning
22. Support and facilitate collaboration across teams
23. Provide resources and tools that make work meaningful
24. Support or embody transformational leadership. (Forsgren, Humble, & Kim 2018)

These capabilities allow the Kessel Run organization to "innovate for the future" and to create value for the Air Force and the warfighter (Sanders, 2019). Some of the value that Kessel Run creates includes providing 18 capabilities in operations, saving "$13M and ~2,350 man-hours per month in Target Development, Air Battle Plan Development, Execution and Mission Reporting" (Sanders, 2019).

In regard to the development and delivery of software, some of the results that Kessel Run has observed include: 1) average time from concept to operations of approximately 4.5 months, 2) reduction of lead time from give years to 3.5 days, 3) the ability to push continuous authority to operate to the secure network in less than one hour, 4) an observed production deployment frequency (capabilities to operations) of 42 capabilities per month, and numerous other improvements and accomplishments (Sanders, 2019).

## C. LOCATION AND OPERATION

Kessel Run operates as a detachment of the Air Force Life Cycle Management Center (AFLCMC), which is located at Hanscom Air Force Base (AFB), Boston, MA. Kessel Run's experimental lab, however, is located in Boston's North End in a shared workspace (Newell, 2018; Ward, 2019). This location appears to be chosen explicitly to attract workplace talent (see Chapter V for details; Pomerleau, 2019).

To determine how Kessel Run operates, we analyzed how a product goes from inception (request) to operation (delivered to warfighter). The team used a project that Kessel Run did for Air Combat Command (ACC) that went from inception to operation

within 88 days, which was the fastest time through Kessel Run to date (Sanders, 2019). The team observed that there were 11 steps/phases to Kessel Run's operation. Steps 1–4 were completed collaboratively between Kessel Run and ACC and resulted in a "Vader Sprint Review," which addresses risks. Steps 5–7 were completed solely by Kessel Run and considered the "Growth" period. Steps 8–11 appear to be testing and release phases, or something known as the "Notional Continuous Delivery + Parallel Test Construct" (Sanders, 2019):

1. Value Stream Mapping
2. Impact Mapping
    a. Identify Target Condition
    b. Key Performance Indicators
3. Opportunity Backlog
    a. Prioritized, Validated Backlog
4. Vader Sprint
    a. De-risking Analysis to Scoping Growth Board
5. Product Scoping
    a. Product Team Resource Allocation
6. Discovering and Framing
    a. Prioritized Backlog
    b. Identify Solution Hypothesis
7. Inception
    a. Review of the Determinations and Findings
    b. Development Kick-Off
8. "Testable"
    a. First "Push to SIPR" (Secret Internet Protocol Router)
9. "Useable"
    a. Beta Test
10. "Useful"
    a. Initial User Adoption
11. "Joyful"
    a. User Adoption
    b. Legacy Sunset. (Sanders, 2019)

## D. FUNCTION

According to Lt Col Sanders's presentation, Kessel Run delivers "user-centered design with lean product development, modern cloud-native web-based mission capabilities, managed application programming interface (API) services with event stream data architecture, Air Force Command and Control (C2) common platform (Kessel Run Enterprise Services)" (Sanders, 2019).

According to its website (n.d.), Kessel Run practices “Lean Product Development,” “Extreme Programming,” and “User Centered Design” (Kessel Run, n.d.). Being lean, the website states, allows them to “validate our assumptions and mitigate risk at every turn.” Extreme programming allows them to “always feel confident to go fast, forever.” Their user-centered approach ensures that they “are always delivering value to our users” (Kessel Run, n.d.). It is apparent that, because of the Air Force’s mission, they pride themselves on their ability to rapidly deliver innovative state-of-the-art software in any domain at any time.

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# V. ANALYSIS

Our analysis includes three forms of data: 1) information provided directly by the Kessel Run staff and leadership, including information posted on official Air Force websites, 2) information collected from interviews from Kessel Run members, and 3) information posted publicly by those outside of the organization. The information collected from Kessel Run includes their official website and information Kessel Run uses in its Enablement Days. Enablement Days are events that Kessel Run organizes to transmit information to the public about the organization. We obtained four interview responses after requesting participation from 14 individuals. The four participants ranged from approximately seven months of experience to two and a half years of experience in the organization. The information posted publicly by those outside of the organization includes news outlets and bloggers that are not affiliated with Kessel Run.

## A. RATIONALE FOR THE CREATION OF KESSEL RUN

### 1. Purpose and Primary Objective

As discussed in the introduction and literature review, federal policy states that commercially available requirements should be contracted out and cost comparisons should be conducted to the maximum extent practicable to determine the best organization for fulfilling a requirement (OMB, 1999). With that being said, we thought that cost might have been an important driver in reverting to developing software in-house rather than outsourcing to contractors. We conducted a spend analysis (Pandit & Marmanis, 1967) that shows that the acquisition cost of software development has been increasing in the Air Force. However, Kessel Run's official statements and interviews suggest another motivation, because cost does not appear to be relevant or at the forefront of their minds. According to Kessel Run's official website (n.d.), the organization's purpose and mission is "continuously delivering war-winning software our airmen love." Additionally, none of the participants mentioned costs as a primary motivation. When asked, "What is the purpose of Kessel Run?" interview respondents had similar sentiments of the organization's purpose: changing the way the Air Force delivers software by continuous

delivery and delivering software the warfighters love. According to one interview response, "Kessel Run is modernizing the Air Operations Center Weapon System through user-centered design, lean start up management and other industry best practices. Our mission is to build and deliver software that warfighters LOVE" (Participant A). Another interview response claimed the purpose was "to change the way the Air Force and DoD delivers software" (Participant B). Furthermore, the third interview response agreed the organizational purpose was "to continuously deliver war winning software that the warfighter loves" (Participant C). Finally, the last interview respondent reported, "To build the capacity to sense and respond to a changing threat environment with software. While we build products that warfighters love, we could throw those products out the window and still have the ability to deliver combat capability. That is the true power of Kessel Run" (Participant D).

### 2. Spend Analysis

We performed a spend analysis that revealed that costs of traditionally procured software development have exponentially increased in recent years. We used the Computer Program and Software Development North American Industry Classification System (NAICS) code 541511 because we concluded that it was most aligned with Kessel Run's mission. Furthermore, we used NAICS code 541511 because the alternative Product and Service Code (PSC) classification system was more confusing and did not provide a clear PSC for software development. The spend analysis was conducted with Federal Procurement Data System (FPDS) and Air Force Business Intelligence (AFBIT) Competency Cell data (AFBIT, n.d.; FPDS-NG, n.d.). While FPDS-NG contains data for all sectors of government contracting, the data pulled from FPDS-NG only included the Contracting Office Agency identification code 5700, which represents Air Force contracting offices. Both FPDS-NG and AFBIT data were separately sorted in chronological order and adjusted for inflation. We converted the raw FPDS-NG and AFBIT data into 2017 and 2018 dollars, respectively, by factoring in the appropriate Consumer Price Index figure from the Bureau of Labor Statistics (Department of Labor, n.d.). Furthermore, we plotted each data on a graph where the Y-axis shows the obligation or spend amount and the X-axis represents years pertinent to the data. A trendline and

equation were generated to define the slope that provides the average change in obligation or spend amount and the best-fit R-squared value for each sample. Figure 1 represents FPDS-NG data measured by obligated dollars from FY2011 to FY2017 and concluded with an average increase of approximately $90 million per year, with an R-squared value of 0.7745.

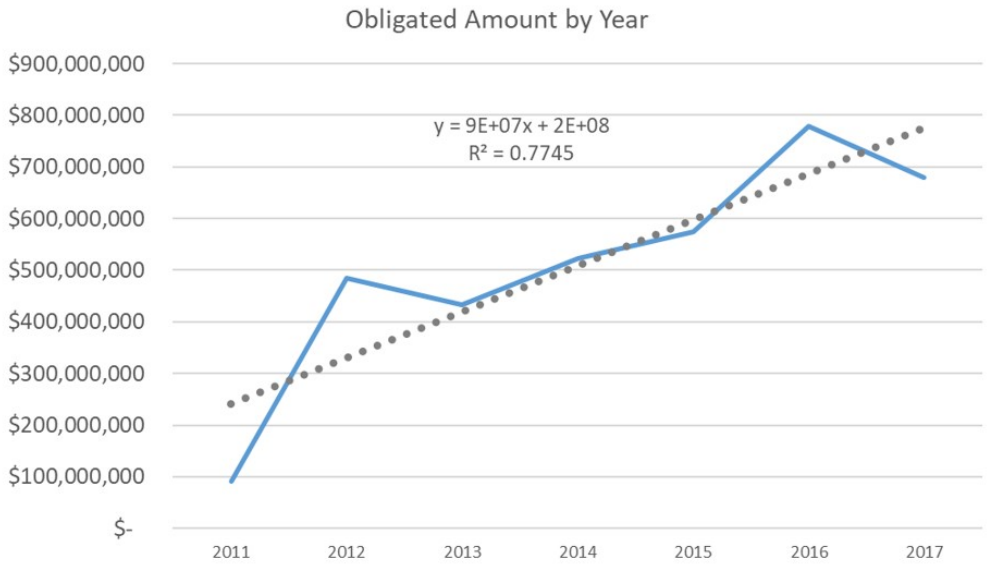


Figure 1. FPDS-NG Data Spend Analysis of NAICS 541511 from FY2011–2017 with a Trendline. Adapted from FPDS-NG (n.d.).

Figure 2 represents AFBIT data measured by spend amount from FY2014 to FY2018 and concluded with an average increase of approximately $100 million per year, with an R-squared value of 0.9392.

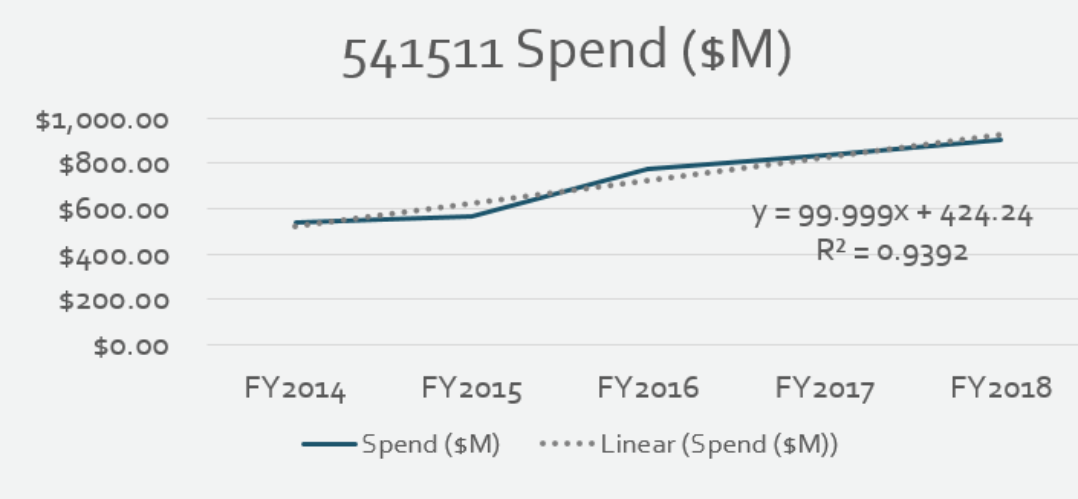


Figure 2. AFBIT Data Spend Analysis of NAICS 541511 from FY2014–2018 with a Trendline. Adapted from AFBIT (n.d.).

The second spend analysis with AFBIT data verifies the Air Force's aggressive increase in average dollars per year spent on software development under NAICS code 541511. While both sets of data have relatively high best-fit R-squared values, indicating that the trendlines are more representative of the data than not, a limitation was identified because the values for FY2014–FY2017 are different between the two sources of data, FPDS and AFBIT. This discrepancy calls the sources of the data into question and provides the appearance of data manipulation before we extracted the data. While limitations to this spend analysis should be acknowledged, these are the official data sets that document government spending for the federal government and the Air Force respectively, and thus represent the best sources of data available. Additionally, both sets of data presented an indisputable substantial increase in Air Force computer programming and software development spending over the years at an average of $90 million and $100 million per year. The spend analysis yields compelling results that could explain the adoption of more agile software development methods by Air Force leaders, such as the creation of Kessel Run.

### 3. AOC 10.2

When asked, "Why was Kessel Run created?" three of four respondents mentioned AOC 10.2. One respondent reported, "Kessel Run was built out of the ashes of a $500M

effort to modernize the AOC Weapon System, originally called AOC 10.2. After spending 10 years and $500M and delivering absolutely nothing, Congress canceled the program" (Participant A). Another interview response was, "The failed 10.2 program [AOC 10.2] opened the door to prove out a different way of software development and delivery" (Participant C). Thirdly, "AOC 10.2 failed to deliver any working software in 10 years. … Rather than continue the old way of doing things, we decided to take the bull by the horns and build software in partnership with industry. That way, the government owns the code and can modify the code as necessary without contracting actions" (Participant D). AOC 10.2 was a project the Air Force contracted with Northrop Grumman to upgrade the Air Operations Center network (Insinna, 2017). After not receiving a finished product in 10 years and spending over $500 million, Congress decided to quit funding the program and the Air Force canceled the project to seek an alternative solution (Insinna, 2017). Flowing from this failure, the Air Force launched AOC Pathfinder, which would include "an agile software development technique called DevOps" and "industry best practices" (Insinna, 2017, para. 3 & 4). Per the interview responses, one respondent explained that Kessel Run was formally known as AOC Pathfinder. Furthermore, one respondent clarified, "Congress cancelled the program and created the AOC Pathfinder, now known as Kessel Run" (Participant A).

#### 4. Agile and Organic Capability

According to bloggers, agile and organic capability seem to be the primary focuses of Kessel Run. Following are two separate bloggers, Steve Kelman (a Harvard faculty member and a former administrator of the Office of Federal Procurement Policy) in the *Federal Computer Week* and the other from Defense Acquisition University (DAU; DAU, 2019; Kelman, 2019b). While expressed in different words, both posts similarly claim that Kessel Run is primarily focused on agility and organic capability. Kelman claimed Kessel Run leverages "both the use of agile and an increasing role for organic capacity in software development—two issues that are not so related but are being pursued together under the moniker 'Kessel Run'" (Kelman, 2019b, para. 1). Furthermore, the DAU blog post said that its "non-standard approach is designed to do two things, speed up the acquisition

process and turn the Air Force into a software company that happens to fly planes" (DAU, 2019, para. 2).

Of the two aforementioned focuses, agility is very apparent because it is even perceived from Kessel Run's organizational name itself. Kelman's blog explains:

> The Kessel Run moniker itself, of course, comes from the original Star Wars movie. In one scene Han Solo is showing Obi-Wan Kanobi [sic] his starship, trying to convince the Jedi of its speed. "You've never heard of the *Millennium Falcon*?" he says. "It's the ship that made the Kessel Run in less than 12 parsecs." So for the Air Force, Kessel Run meant speed, which is what the Air Force was trying to do with agile. (Kelman, 2019b, para. 12)

Focusing so heavily on agility has been a struggle for the DoD, which has been bounded by the slow, bureaucratic style of the traditional acquisition system. According to an interview with Lt Col Jeremiah Sanders, the DAU blog revealed, "Traditional acquisition and software development can't keep up with the rate of change or challenges from our enemies" (DAU, 2019, para. 3). According to *Defense News*, Air Force Secretary Heather Wilson admitted that the DoD and Air Force are "terrible at buying software," but she added that "Kessel Run was changing that paradigm" (Insinna, 2019, para. 10). When asked, "How has outsourcing proven to be less effective?" the frustrations toward the traditional acquisition method can be summed up in two areas: 1) we do not own the work and intellectual property, and 2) the process is long and cumbersome. Two of the respondents went even further to explain that software development requirements normally take so long that, with the changing pace of the environment and needs, the requirement is inadequate or irrelevant once delivered to the warfighter. According to an article in C4ISRnet, Air Operations Branch Chief Adam Furtado stated, "Most of the things we're doing here are highly logical; … it has taken us a long time to figure out all of the mechanisms behind it to get there" (Pomerleau, 2019, para. 14). Furthermore, commercial industry generally adopted these processes about a decade ago (Pomerleau, 2019, para. 14). From the data gathered, it appears that the DoD is well aware their software development practices are outdated and unable to effectively enable the mission.

According to the Federal Computer Week blog, the organic capability was more coincidental than intentional (Kelman, 2019b). As the Program Executive Officer Digital,

Steve Wert was more concerned with improving agility no matter the mix of government and contractor blend (Kelman, 2019b). Furthermore, he elaborated, "We were primarily looking to demonstrate that modern commercial practice could be successfully applied at scale with the DoD" (Kelman, 2019b, para. 10). As indicated by one of the interview responses, owning the work and intellectual property and knowing software development practices is instrumental in Kessel Run's effectiveness. As one respondent reports, "Having in-house expertise ensures that the Government owns the code baseline and the product development … The other element is that when we do contract with companies to provide service-based support, we have the in-house technical ability to assess whether a company is performing appropriately" (Participant A).

As demonstrated above, the agility and organic capability appear to be important to Kessel Run and represent a completely different approach to how the DoD normally operates regarding software development. Furthermore, cost does not seem to be a major point of concern when it comes to agility. However, interview respondents were frankly concerned that the slow delivery of software through traditional approaches hinders the warfighter from obtaining relevant software. An interview respondent explained, "The information we're planning off of has changed and may no longer be valid or important" (Participant B). Another respondent answered, "Traditional acquisitions lends itself to a waterfall approach, i.e., requirements, contract award, development, test, security, compliance, and then fielding. This sequence of events takes more than ten years on average. This means that the warfighter goes 10+ years without the software they need" (Participant D). The fact that the warfighter is not supported appropriately because of acquisition bureaucracies and inefficiencies is extremely alarming and the Air Force has recognized this deficiency.

In their exploration to discover the best solution, the Air Force created Kessel Run to put their Airmen through coding training and make them as competent as Silicon Valley software developers (Kelman, 2019b; WTOP, 2019). According to Kelman's blog, "Wert did not originally have in-house software developers on his staff. They used some airmen already at Hanscom, and supplemented this by finding airmen coders throughout the Air Force (usually not working in acquisition) and training them on agile through a six-month

temporary duty assignment" (Kelman, 2019b, para. 11). *Washington's Top News* stated, "Part of this revolution in 'how things are done' was to build a software lab in Boston that was modeled after successful Silicon Valley companies" (WTOP, 2019, para. 8). Interview subjects reported several benefits to airmen trained on software development in lieu of outsourcing:

- Owning the software and intellectual property
- Reduction in the contractor's competing goals
- Government open source model enables sharing between teams
- Efficient tactical strategic execution with government code repository
- Ability to assess contractor's performance (Participants A, B, and D)

## B. METHODS USED TO DESIGN KESSEL RUN

### 1. Basis of Inception

Interviewees' responses revealed a couple of notable trends when asked, "Did Kessel Run borrow ideas or concepts from other programs/organizations? If so, what were they?" To sum up these trends, 1) Kessel Run got their ideas from industry, and 2) most respondents listed literature that was important to inception of Kessel Run.

According to the DAU blog post, "The Kessel Run Experimentation Lab is not your typical DoD program—it's not located on a military installation, you won't see anyone wearing a suit and it's driven by an almost frenetic need to innovate" (DAU, 2019, para. 1). Furtado explains, "We're battling industry, especially in Boston, for top end tech talent. … You can't ask people to hey come and take a $30,000 pay cut also it's going to be a bad environment and you're not going to be happy here" (Pomerleau, 2019, para. 5). Defense.gov summarizes the "New Workforce" with three facts: 1) born between 1980–2000, 2) prefers cities or large towns, and 3) would trade other benefits for better workspace (Newell, 2018). Kessel Run is challenged to interface with and develop methods to attract millennials in that workforce (Newell, 2018). Consequently, Kessel Run operates out of a "brightly lit We Work office" in Boston (Ward, 2019, p. 59). Defense.gov revealed,

"WeWork's shared innovation space in Boston's North End is usually home to constantly shifting startup companies, but the T-shirt-and-jeans-wearing airmen milling around its fully-stocked kitchenette sounded a bit different from their similarly dressed office mates. … This shared space, occupied by a smattering of startups, will also serve as the Air Force's Kessel Run Experimentation Lab (KREL)" (Newell, 2018, para. 2).

Not only did the Air Force adopt industry's practices to attract top tech talent, but Kessel Run also took a page out of industry's coding practices by employing continuous delivery methods (Johnson, 2019). As previously stated, the waterfall approach of traditional acquisitions takes years. According to an interview response, "There are numerous companies who continuously deliver software. Even though we're the government, why couldn't we get to a state where we were also able to do it. Companies, such as Amazon, Google, and Pivotal, have provided numerous lessons learned that we can use to grow" (Participant D). Using continuous user feedback loops, continuous delivery means software is delivered in weeks and is reiterated to make it better throughout its use. It is not a final end-product that takes years to deploy without effective feedback mechanisms (Johnson, 2019). One of Kelman's blogs includes an interview with Colonel Enrique Oti at the Code for America Summit (Kelman, 2018). Colonel Oti is now the detachment commander for Kessel Run and explained to Kelman, "Continuous testing of increments of software is crucial to speeding up deployment, and prevents the do-loop of software not being tested till the end, problems discovered, and a cycle of fixes and re-tests. It is never perfect the first time around, but changes can be made based on feedback from initial use" (Kessel Run, n.d.; Kelman, 2018, para. 12).

In addition to the Enablement Days presentation entitled "Kessel Run Agile Imperative," interview respondents listed literature important to the development of Kessel Run. The following is a list of the literature that was mentioned in either forum:

- Start Up Way
- Development and Software Operations (DevOps) Research and Assessment (DORA)—State of DevOps

- Accelerate: Building and Scaling High Performing Technology Organizations
- Sense and Respond
- How Google Works
- Lean Enterprise
- The Lean Startup
- Extreme Programming
- Design Thinking

The continuous delivery method mentioned in the previous paragraph is aligned with DevOps, which initially produces a "minimally viable product" (Rosenberg, 2019, para. 5). According to Chaillan, the co-director of the DoD Enterprise Development, Cyber Security, and Software Operations (DevSecOps) Initiative, "When you add cybersecurity experts to this process, working alongside both the developers and the users/operators from the beginning to ensure the code isn't easily hacked, DevOps becomes DevSecOps" (Rosenberg, 2019, para. 6). According to one participant, "Kessel Run utilizes industry and Silicon Valley best practices like lean start up management, user-centered design, and DevSecOps" (Participant A). One respondent emphasized that *The Lean Startup* "was essentially our Bible" (Participant D). The Air Force was ultimately launching its own tech startup with Kessel Run, and these books provide insight on how they began building the organization. As one respondent noted, "We were very scrappy at the beginning. As a product designer, I used my personal laptop to get the job done" (Participant D). That statement provides a clearer picture of Kessel Run as a startup and how it shares similar struggles with other tech startups.

### 2. Organizational Metrics

In accordance with an interview response, "These [metrics] collectively allow us to gauge the health of our software development and deployment. Our actions have significantly improved these metrics as compared to baseline from which we started" (Participant D). While one interview in particular provided more details than the others regarding the organization's metrics, all respondents listed the four Software Delivery Performance Metrics from *Accelerate*:

- Deployment Frequency
- Lead Time
- Mean Time to Restore
- Change Failure Rate

These metrics were also mentioned in the Kessel Run Agile Imperative briefing. Moreover, the briefing categorizes the Software Delivery Performance Metrics as measuring the process and mentions an additional metric for measuring the outcome called "The One Metric That Matters (OMTM)." This metric answers the question posed by the chief of staff of the Air Force: "What combat capability are you delivering?" (Sanders, 2019). The purpose of the OMTM is to "drive dynamic resource decisions" (Sanders, 2019). One of the interview respondents defines it as "the 'north star' which determines whether a product is bringing user value" (Participant A). Along with these metrics, one respondent expressed interest in calculating Kessel Run's personnel turnover rates because "I [Participant D] want to make Kessel Run the place where people want to come and work" (Participant D). This metric could help the organization understand whether members in the organization are dissatisfied and identify ways to retain personnel, which seems to be their most important resource. Likewise, it is interesting that cost is not included as a significant metric to Kessel Run, neither included in the Enablement Days resources nor mentioned by the interviewees; we had initially considered cost important based on our spend analysis results. The organization may be performing cost efficiently enough that cost is not a significant concern to them, or they might be leveraging improved

practices to reduce costs; however, it appears that no metric exists to validate either statement.

### 3. Obstacles and Challenges

An organization like Kessel Run had obstacles and challenges it had to overcome in order to gain the position it has today and the recognition it has received. The interview respondents primarily keyed in on the obstacle of gaining senior leadership's trust, and the challenge most interviewees disclosed was communication among all of the stakeholders.

The obstacle most mentioned in the interviews was gaining the Air Force acquisition leader's trust in taking a new approach in DoD software development. As stated by one respondent,

> The hardest part was gaining senior leaders' trust on a completely different approach. ... not doing requirements-based development was a radical change for them. We had to convince leadership to allow us to talk to our users, cloud enabled IT can provide mission assurance, test and security can be incorporated into the development process, and we should use commercial IaaS [Infrastructure as a Service] and PaaS [Platform as a Service] instead of trying to build our own. Also, had to be honest with them that our culture and infrastructure suck so bad it's [impeding] success for innovation, culture sucks because we have way too many gates before we can get to the user (lack of trust) and engineers are just watching people work and infrastructure because we can't develop software and attract top talent in our crumbling infrastructure at Hanscom afb [Air Force Base] (both networks and facilities). (Participant C)

Another respondent shared,

> Fear of the unknown. Most of the senior leaders in AF acquisitions have been in their profession a long time. As people grow in their career, they generally become more risk adverse because there is no incentive to take risks. Taking risks is actually a disincentive. A shift from being completely requirements driven to a combination of what I call big "R" requirements (as laid out by ACC) and small "R" requirements (gathered through user-centered design) was met with much skepticism. Accepting that we don't know everything upfront was quite the mindset shift. We learn more as we iterate. We had to educate senior leadership about how not knowing everything upfront and then building things in small increments buys down the level of risk you incur. In addition to fear of the unknown, we had a culture that didn't optimize for doing the best thing for the user. Recognizing that culture had a lot of room for improvement allowed us to

> make the necessary changes to be more user-focused, attract top talent, and make decisions based on ideas and context, not rank. (Participant D)

As previously mentioned, Kessel Run is taking a new approach to software development across both the Air Force and the DoD. While it may seem like the obstacle Kessel Run faced is nothing special, it is a considerable stumbling stone when trying to be agile. As another interview expressed, "It makes it difficult sometimes to get things done" (Participant A).

Kessel Run has a couple of years under its wings now and its first software development project, Jigsaw, "saves $12M a month in fuel costs based on a more efficient process" (Pomerleau, 2019, para. 10); however, it faces continuing challenges with communication, or as one respondent put it simply, "Getting all the players on board with clear messaging" (Participant B).

Interacting with customers can also be a challenge. Kessel Run's portfolio of software development spans across multiple Air Operation Centers. According to one interview response, "Each AOC operates differently and not according to doctrine. As we scale out our capabilities to other AOCs we are gathering new feedback and building new features to obtain user adoption at other sites" (Participant C). Another respondent explained,

> Each AOC thinks they are a snowflake. The commonalities we've discovered through our research process show otherwise, but no one wants to be told they aren't special. The key is balancing the special needs of user bases while building out an enterprise solution and proving that to our users. Many of our users are skeptical because they've been using shitty software and workarounds for 20+ years. It's hard to imagine a reality where modern software enables you do to do your job more effectively and efficiently across the globe. (Participant D)

The challenges faced in Kessel Run seem to be generally directed toward their users at the AOCs; however, while they may have issues with interfacing with AOCs, the AOCs appear to be a priority to Kessel Run as users.

### 4. Successes and Impacts

When asked "What are Kessel Run's notable successes?" three respondents mentioned the continuous Authority to Operate (ATO) and two respondents mentioned psychological safety between the variety of responses. For example, one participant's explanation regarding continuous ATO was, "We have achieved continuous delivery on SIPR for the AOC. To do this we have a continuous ATO and have embedded the DT (Developmental Test)/OT (Operational Test) testers into our development teams" (Participant C). Additionally, another participant said, "Continuous ATO on SIPR to enable us to achieve continuous delivery. The timeline to push to production has dropped dramatically as a result of what a continuous ATO of our platform has done for us" (Participant D). According to an article,

> One unexpected area of success the team has generated is achieving the first continuous authority to operate on DoD networks. The authority to operate is a process by which entities are granted permission to connect systems to federal networks following a variety of validated security steps. A continuous authority means solutions and software fixes go up on the network immediately without having to jump through the validation hoops each time. As a result, this means solutions get to warfighters faster given they go up to the network immediately rather than waiting through the process. (Pomerleau, 2019, para. 12)

In sum, Continuous ATO is a best practice adopted from industry which replaces the process of testing all of the code at the end of the project and makes developing software quicker (Pomerleau, 2019). Essentially, Continuous ATO allows Kessel Run to constantly be working instead of waiting for approvals, which can take time.

Secondly, one of the interview responses regarding psychological safety is quoted here:

> Things like psychological safety are valued so the most optimal decisions can be made. The traditional military hierarchy that enabled Platoon leaders to navigate the jungles of Vietnam don't work for a modern software organization. The highest ranked person doesn't always have the context or knowledge to make or inform the decision; our flat management structure at the product team level allows decisions to be made by the right people. (Participant D)

Psychological safety appears to be very important to the organization and its success. While obtaining a list of interview participants and when asked to briefly explain how the list of names were selected, a key informant responded, “At Kessel Run, we don’t concern ourselves with rank. We put the best people in the roles, whether they are an E-5 or a 2Lt (Second Lieutenant)” (participant, personal communication, October 1, 2019). Furthermore, one blogger reported, “It is not every 36-year Air Force old-timer who is willing to listen to kids in hoodies, and even to allow them to name a pet project after a favorite Star Wars trope. (Kudos to the Air Force as well for not squelching this name.)” (Kelman, 2019b, para 19). This enables Kessel Run’s innovation and ability to obtain useful information from any source without dealing with the same bureaucracy witnessed in the rest of the Air Force and DoD.

When asked “How has Kessel Run impacted the Air Force’s software development capabilities?” many of the respondents noted that Kessel Run pioneered a different way to deliver software to the Air Force and former Kessel Run members launched more software factories in the Air Force, including:

- Section 31
- BESPIN
- LevelUp
- SpaceCamp (Participants C and D)

One respondent answered, “The largest impact is the conversation Kessel Run has started” (Participant B). By leading the way for change in Air Force software development, Kessel Run has started the conversation of operating differently and adopting industry’s best practices and enabled the potential for more radical changes in the military.

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# VI. CONCLUSION

## A. SUMMARY OF FINDINGS

### 1. Rationale for Kessel Run's Inception

One of the research questions we set out to answer in this case study was, "Why did the Air Force decide to internally develop (insource) software using the Kessel Run organization in lieu of the traditional method of contracting for software (outsource)?" Initially, we believed that rising software development costs drove the desire to create Kessel Run. Viewed through the lens of the make-or-buy decision, it appeared that the decision to insource made sense from a cost perspective. Based on spend data analysis, the cost of contracting for software development has increased dramatically over the last five years. As the failed AOC 10.2 project demonstrated, the cost of capabilities the Air Force sought to procure far outpaced the actual value of the end result. In an era of ever-tightening budgets and fiscal hawks seeking to cut costs, any budget item that shows increasing costs gets put in the crosshairs—sighted up for elimination. The spend data analysis supports the idea that software procurement costs are rising, and we anticipated interview responses to identify costs as a reason for establishing Kessel Run.

Despite the costly and doomed-to-fail AOC 10.2 program giving Kessel Run the opportunity to exist, and the general increasing trend in costs for software development, our analysis discovered that cost metrics were not one of the primary focuses of the organization. Indeed, cost savings appear to be more of a welcome but unintended side effect of Kessel Run's success. Based on our analysis of official communication, interviews with Kessel Run members, and external sources, Kessel Run was created to continuously deliver war-winning software for the warfighter at an unprecedented pace (A. Graham, personal communication, August 13, 2019). Delivering capable and responsive capabilities to their end user is the motivator for Kessel Run personnel. Kessel Run, it appears, was created to insource and develop capabilities.

### 2. How Kessel Run Was Developed

The second research question was, "How did the Air Force develop the Kessel Run organization?" Traditionally, military bureaucracy is slow to act and slow to change. In this organization, steeped in hierarchical structures and procedurally-based actions, new initiatives take time to develop. Federal policy appears to prioritize commercial activity contracting versus competing with the private sector as well as cost reduction versus core competency focus. However, Kessel Run sought to return the software development capacity back to the military. Seemingly somewhat out of line with federal policy, the organization prioritized competency development with no direct goal of reducing costs.

Based on analysis of Kessel Run's published literature, personnel interviews, and information from outside of the organization, Kessel Run circumvented the traditional bureaucracy by learning and imitating industry best practices. Founding members leaned heavily on startup literature such as *The Lean Startup* to establish the organization's identity. Organizing and behaving like a startup company instead of a traditional military organization enables Kessel Run to attract top talent, swiftly respond to customer needs, and deliver capabilities at a rate unmatched in traditional government procurement.

## B. WHY IT MATTERS

Why does Kessel Run matter? Because the end user and the Air Force mission matter. Kessel Run has adopted a proven civilian method to develop, administer, and maintain software in a very short amount of time and at a cost much lower than the traditional method of procurement.

The most impactful aspect of Kessel Run's success is the organization's delivery, administration, and maintenance of effective software for the warfighter. The organization's ability to overcoming the shortfall of the AOC 10.2 program through continuous capability development is the support the warfighter deserves. Kessel Run is built around the Air Force's mission and their dedication to the warfighter. It is apparent that they pride themselves on their ability to rapidly deliver innovative state-of-the-art software in any domain at any time.

The second takeaway is that Kessel Run has shown that alternatives to the traditional procurement cycle can be effective and can work within the Air Force. Kessel Run was able to circumvent the typical military bureaucracy by adopting the practices and methods of new-age startup tech companies as well as large established tech companies, like Google. Removing or reducing red tape and embracing an agile, innovative structure can deliver positive products, reduce timelines, and save money. Kessel Run is proof that the standard operating mode of military software development can be deviated from and benefit end users and the Air Force as a whole.

## C. RECOMMENDATIONS

### 1. Kessel Run Recommendations

Kessel Run has proven that a nontraditional organization can benefit the Air Force. However, that does not mean that a Kessel Run-type organization is the right response to all procurement shortcomings. Based on our findings, however, the Air Force should explore areas where Quinn and Hilmer's (1994) second question of the make-or-buy analysis—what vulnerabilities exist if the market fails outsourced needs—represents unacceptable risk to mission execution and determine if insourcing the capability is a viable alternative. Although a startup-structured organization may not be the best way to insource in all situations, asking the question of whether or not something should be insourced will force the Air Force to identify areas of risk to mitigate if necessary.

### 2. Further Research Recommendations

Our review of federal policy revealed that policy prioritizes commercial contracting, except in specific circumstances, and prioritizes cost minimization. With that being said, Kessel Run appears to do the exact opposite; the organization has insourced previously outsourced capabilities and prioritized metrics that do not track cost. The benefits of focusing on developing software competency through insourcing has led to better, timely-delivered products. Further research should be done to review other federal government contracting efforts related to outsourcing capabilities to determine if the efforts are in line with federal policy or if they could benefit from deviating from policy as Kessel Run has done.

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